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## AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

**LISTING OF CLAIMS**

1. (currently amended) A system comprising:

a) a laser operable to emit <u>a</u> femtosecond laser beam pulse;

b) a binary phase shaper operable to shape the pulse; and

c) a controller operable to control the laser and the shaper.

2. (original) The system of Claim 1, wherein the shaper employs two phase values separated by $\pi$.

3. (original) The system of Claim 1 further comprising multiphoton intrapulse interference phase scan for pulse characterization and compensation.

4. (original) The system of Claim 1 further comprising evolutionary learning calculations.

5. (original) The system of Claim 1, wherein the system is employed in multiphoton microscopy.

6. (withdrawn) The system of Claim 1, wherein the system is employed in an optical communications system.

7. (original) The system of Claim 1, wherein the pulse shaper has one of the following pixel resolutions: (a) about 128; (b) about 512; (c) about 640; and (d) about 1024.

8. (original) The system of Claim 7, wherein the bandwidth of the laser is dispersed across all pixels of the phase modulator.

9. (original) The system of Claim 1, wherein the system is employed in optical coherence tomography.

10. (withdrawn) The system of Claim 1, wherein the system is employed in microlithography.

11. (original) The system of Claim 1, wherein the system is employed in functional imaging.

12. (withdrawn) The system of Claim 1, wherein the system is employed in quantum information processing.

13. (withdrawn) The system of Claim 1, wherein the system is employed in nonlinear optical excitation spectroscopy.

14. (original) The system of Claim 1, wherein the system is employed in photodynamic therapy.

15. (withdrawn) A system comprising:

a) a laser beam pulse;

b) a binary phase shaper operable to shape the laser beam pulse with encoded characteristics;

c) a nonlinear optical medium operable to separate multiple frequencies of the pulse;

d) a detection device operable to detect the characteristics of the shaped laser beam pulse as separated by the nonlinear optical medium; and

e) a unit connected to the device operably decoding the characteristics.

16. (withdrawn) The system of Claim 15, wherein the laser beam pulse is encoded with a routing address.

17. (withdrawn) The system of Claim 16 wherein the laser beam pulse is encoded with multiple routing addresses and a second, subsequent laser beam pulse is emitted from the laser and is also encoded by the pulse shaper with multiple routing addresses.

18. (withdrawn) The system of Claim 17 wherein each routing address contained in the laser beam pulse is encoded by the pulse shaper and corresponds to separate frequencies after second harmonic generation.

19. (withdrawn) The system of Claim 17 wherein the laser beam pulse is encoded with communications message data.

20. (withdrawn) The system of Claim 15 further comprising:

a main transmitting controller; and

multiple remote initial-transmitting sources connected to the transmitting controller;

the main transmitting controller operably causing the pulse shaper to encode multiple successive laser beam pulses differently in an active manner.

21. (withdrawn) The system of Claim 20 wherein the main transmitting controller, laser beam pulse and pulse shaper act as a main communications transmitter to send encoded optical signals to the to a receiver, including the detection device and the nonlinear optical medium which is a crystal, in order to decode the characteristic in an asynchronous manner without autocorrelation and without interferometry.

22. (withdrawn) The system of Claim 15 further comprising a fiber optic cable carrying the laser beam pulse from the pulse shaper.

23. (withdrawn) The system of Claim 15, wherein the detecting device includes a detector array to decode the characteristics defining a communications message.

24. (withdrawn) The system of Claim 15, wherein the laser beam pulse of less than about 50 femtosecond pulse duration.

25. (withdrawn) The system of Claim 15, wherein the detecting device includes an array of optical fibers with multiples of the unit being connected downstream of the corresponding fibers.

26. (original) A system for use with living tissue, the system comprising:

a high peak intensity laser beam pulse; and

a device operable to change a characteristic of the pulse prior to emission of the pulse upon the living tissue through use of multiphoton intrapulse interference;

wherein nonlinear transitions induced by each pulse are controlled by binary phase shaping.

27. (original) The system of Claim 26 wherein the device uses a pulse shaper and the desired excited substances in the tissue undergo two photon absorption.

28. (original) The system of Claim 26 wherein the pulse has a duration of less than fifty one femtoseconds.

29. (original) The system of Claim 26 further comprising generating an optical tomography image produced by the shaped pulse passing through the tissue.

30. (original) The system of Claim 26 wherein the device is a pulse shaper which enhances two photon absorption by a therapeutic substance and substantially prevents three photon induced damage of adjacent healthy tissue.

31. (original) The system of Claim 26 wherein the device includes a phase modulation mask operably modifying the beam.

32. (original) The system of Claim 26 wherein the pulse is shaped to enhance targeted multiphoton damage to modify or destroy certain molecules in the living tissue.

33. (original) The system of Claim 26 wherein the multiphoton intrapulse interference operably activates desired photodynamic therapy agents at desired tissue depths.

34. (previously presented) A system for multiphoton microscopy, the system comprising:

a) a femtosecond laser operable to emit a laser pulse;

b) a target operable to hold a sample in the pulse;

c) the sample operably labeled with at least one fluorescent probe;

d) a binary phase shaper operable to shape the pulse to selective excitation of the probe; and

e) a detector operably detecting an emission from the sample.

35. (original) The system of Claim 34, further comprising multiple probes.

36. (original) The system of Claim 35, wherein the shaper operably shapes a probe to selectively excite each of the multiple probes.

37. (original) The system of Claim 34, wherein the probe includes fluorescent nanoparticles.

38. (original) The system of Claim 34, wherein the probe is a chemically sensitive fluorescent probe for detecting at least one of: H+, Na+, and Ca++ ions.

39. (original) The system of Claim 34, further comprising learning calculations.

40. (original) The system of Claim 34, further comprising a controller operably controlling the laser, the shaper, the target and the detector.

41. (original) The system of Claim 40, wherein the controller is part of a microprocessor.

42. (original) The microprocessor of Claim 41, further comprising a data collector operably collecting data from the detector.

43. (original) The microprocessor of Claim 42, further comprising a data analyzer operably analyzing the data that is collected.

44. (original) The system of Claim 34, wherein the shaper is comprised of different phase masks permanently created in a substrate.

45. (original) The system of Claim 34, wherein the detector operably converts the emission so that it is viewable by a human eye.

46. (original) The system of Claim 34, wherein the sample is labeled with quantum dots.

47. (original) A method for microscopy of a target material containing probes that are excitable by multi-photon excitation, the method comprising:

a) generating a laser pulse;

b) shaping the pulse using a binary phase shaper so that the pulse selectively excites a desired probe;

c) directing the shaped pulse at the target; and

d) detecting emissions from the target.

48. (original) The method of Claim 47, further comprising shaping the pulse by the use of learning calculations.

49. (original) The method of Claim 47, wherein the target has multiple probes.

50. (Previously Presented) The method of Claim 49, further comprising shaping a pulse to selectively excite each of the multiple probes.

51. (original) The method of Claim 47, further comprising shaping the pulse with a spatial light modulator.

52. (original) The method of Claim 47, wherein the laser pulse is less than 51 femtoseconds, further comprising observing the target with a confocal microscope.

53. (original) A method of pulse shaping, the method comprising:

a) emitting a laser pulse having a duration less than 110 femtoseconds;

b) directing the pulse into a pulse shaper;

c) characterization of the pulse using multi-photon intrapulse interference phase scan; and

d) shaping the pulse by only two phase values.

54. (original) The method of Claim 53, further comprising using the shaped pulse in multi-photon microscopy.

55. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in optical communications.

56. (original) The method of Claim 53, further comprising using the shaped pulse in non-linear optical excitation spectroscopy.

57. (original) The method of Claim 53, further comprising using two phases separated by $\pi$.

58. (withdrawn) The method of Claim 53, wherein the pulse contains data.

59. (original) The method of Claim 58, further comprising using a spatial light modulator.

60. (original) The method of Claim 59, further comprising shaping the pulse with the spatial light modulator having one of the following pixel resolutions: (a) about 128; (b) about 512; (c) about 640; and (d) about 1024.

61. (withdrawn and currently amended) The method of Claim 58 [[60]], wherein the amount of data transmitted in the pulse is equal to or less than 128 bytes per pulse.

62. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in microlithography.

63. (currently amended) The method of Claim 77 [[53]], further comprising using the shaped pulse in photodynamic therapy on living tissue ~~optical communications~~.

64. (withdrawn and currently amended) The method of Claim 77 [[53]], further comprising using the shaped pulse in nonlinear optical excitation spectroscopy.

65. (original) The method of Claim 53, further comprising using the shaped pulse in optical coherence tomography.

66. (currently amended) The method of Claim 77 [[53]], further comprising using the shaped pulse in multiphoton microscopy.

67. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in quantum computing.

68. (original) The method of Claim 53, further comprising using the shaped pulse in photodynamic therapy.

69. (withdrawn) The method of Claim 53, further comprising using the shaped pulse in microfabrication.

70. (original) The method of Claim 53, further comprising shaping by binary phase shaping.

71. (original) An optical system comprising:

a laser beam pulse;

a carrier; and

powder secured to the carrier;

the pulse at least partially passing through the powder-covered carrier.

72. (original) The system of Claim 71 further comprising a detector receiving the second harmonic generated by the pulse after transmission through the powder on the carrier and a controller connected to the detector, the controller operably characterizing the spectral phase of the pulse.

73. (original) The system of Claim 71 wherein the pulse includes multiphoton intrapulse interference characteristics.

74. (original) The system of Claim 71 wherein the pulse has a duration less than about 51 femtoseconds.

75. (original) The system of Claim 71 wherein the powder includes Potassium Dihydrogen Phosphate.

76. (original) The system of Claim 71 wherein the powder includes Barium Borate.

77. (previously presented) A method of pulse shaping, the method comprising:

a) emitting a laser pulse;

b) directing the pulse into a pulse shaper; and

c) characterization of the pulse using multi-photon intrapulse interference phase scan.

78. (previously presented) The method of Claim 77 wherein the pulse has a duration less than 51 femtoseconds.

79. (previously presented) The method of Claim 77 further comprising automatically compensating for undesired pulse characteristics.

80. (previously presented) The method of Claim 77 further comprising selectively reducing three or more photon excitation.

81. (previously presented) A system comprising:

a laser operably emitting a laser beam pulse;

a controller; and

an optic unit, connected to the controller, automatically measuring and compensating for spectral phase distortion of the pulse.

82. (previously presented) The system of Claim 81 wherein the pulse has a duration less than 51 femtoseconds.

83. (previously presented) The system of Claim 81 further comprising selectively reducing three or more photon excitation.

84. (previously presented) The system of Claim 81 wherein the optic unit includes a pulse shaper.

85. (previously presented) The system of Claim 81 wherein the optic unit yields a transform-limited pulse.

86. (previously presented) The system of Claim 81 wherein the optic unit yields a user-specified shaped pulse.

87. (previously presented) The system of Claim 81 wherein the optic unit includes a second-harmonic generation crystal and a spectrometer to obtain the second harmonic spectrum of the pulse.

88. (previously presented) The system of Claim 81 wherein a reference phase function is introduced into the pulse by the optic unit, the output is frequency doubled and the second harmonic spectrum is detected in a spectrometer, the controller determines the phase distortion, and then the phase distortion is subtracted when subsequent phase functions are introduced by the optic unit to compensate for phase distortions of the input laser pulse.

89. (previously presented) The system of Claim 81 wherein the optic unit includes a spatial light modulator which both introduces a reference phase and compensates for phase distortions.

90. (previously presented) The system of Claim 81 wherein the controller automatically calculates the second derivative of a spectral phase from a collection of second harmonic spectra obtained as a referenced phase is scanned, and the spectral phase is obtained by integration.

91. (previously presented) The system of Claim 81 wherein the optic unit introduces a binary phase function to the pulse in addition to a compensation phase.

92. (previously presented) A system comprising:

a laser operably emitting a laser beam pulse of less than 51 femtoseconds;

a pulse shaper operably controlling a spectral phase of the pulse;

a detector operably detecting a spectrally dispersed second harmonic of the shaped pulse; and

a controller connected to the shaper and detector, the controller operably controlling the shaper to introduce multiphoton intrapulse interference to the pulse.

93. (previously presented) The system of Claim 92 wherein the pulse has a duration less than 10 femtoseconds.

94. (previously presented) The system of Claim 92 further comprising selectively reducing three or more photon excitation.

95. (previously presented) The system of Claim 92 wherein a calibrated reference spectral phase in the pulse shaper is used to retrieve an unknown spectral phase in subsequent pulses.

96. (previously presented) The system of Claim 92 further comprising using a reference spectral phase including a sinusoidal function with the pulse shaper.

97. (previously presented) The system of Claim 92 further comprising using a reference spectral phase including a cubic function with the pulse shaper.

98. (previously presented) The system of Claim 92 further comprising a retrieved unknown spectral phase in the pulse is used to calculate a compensation phase that cancels spectral phase distortions in subsequent laser beam pulses.

99. (previously presented) The system of Claim 92 further comprising using the shaper and controller to conduct multiphoton intrapulse interference phase scans on subsequent laser beam pulses in an iterative manner to improve the quality of pulse control.